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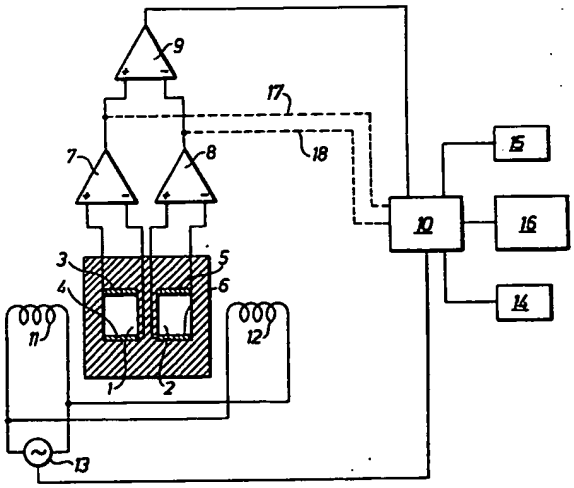
(54) An arrangement for the measurement of the difference between two flows in two separate ducts.

(57) An arrangement for the measurement of the difference between two flows in two separate ducts with the help of one or more monitoring electrodes or the like arranged in respective ducts. The flow in the one duct is adapted so that it is capable of being transferred to the other duct. This can be done, for example, with the help of means for the alternate change-over of the flows from the respective ducts to the opposite duct, so that ultimately all the electrodes and/or duct walls are acted upon to a substantially equal extent.

Alternatively this may be achieved with the help of means for conducting one and the same flow through both ducts when the flow difference becomes zero and the measured value can be used as a new zero value for the continued measurement.



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TITLE

AN ARRANGEMENT FOR THE MEASUREMENT OF THE DIFFERENCE BETWEEN TWO FLOWS IN TWO SEPARATE DUCTS

TECHNICAL FIELD

The present invention relates to an arrangement for the measurement of the difference between two flows in two separate ducts with the help of one or more monitoring electrodes or the like, arranged in respective ducts.

The invention relates first and foremost to the measurement of relatively small differences between two relatively large flows. The invention may be applied, for example, to the measurement of ultrafiltration in a dialysis system, where the continuing clean dialysis solution flows through the one duct, whilst the same solution, but increased through ultrafiltration in the dialyser, flows through the other duct. The two main flows may be of the order of magnitude 500 ml/min whereas the difference, that is to say the ultrafiltration, may be somewhere between 0 and 40 ml/min and exceptionally a little higher.

BACKGROUND ART

In British patent specification 2 003 274 and in British patent application 2 056 691 two similar systems of electromagnetic measurement are described. In both systems the flows whose difference is to be measured pass through two parallel ducts. In accordance with the firstmentioned publication the measurement is performed with the help of three electrodes which are acted upon as a function of the flowing medium and an external magnetic field. In accordance with the lastmentioned publication two main electrodes which co-operate with a number of earth electrodes are instead acted upon in the same manner.

Both systems suffer from the disadvantage that the flowing media act upon the two ducts, or the electrodes, in a different manner. If, for example, the designs are used for the measurement of ultrafiltration in dialysis, deposits from the contaminated liquid are obtained on the electrodes and/or on the actual duct walls. Even a deposit in the order of magnitude of a few μ may cause substantial errors in the readings.

DISCLOSURE OF INVENTION

The invention thus relates to an arrangement for the measurement of the difference between two flows in two separate ducts with the help of one or more monitoring electrodes arranged in respective ducts. The abovementioned problem is solved in that the flow in the one duct is adapted so that it is capable of being transferred to the other duct. Means may be provided, for example, for the alternate change-over of the flows from the respective ducts to the opposite duct, so that ultimately all electrodes and/or duct walls are acted upon to a substantially equal extent. This realization has the advantage that the dialysis or any other continuing treatment can proceed without interruption.

Alternatively means may be provided for the conducting of one and the same flow through both ducts, when the difference in flow becomes zero, and the measured value can be used as a new zero value for the continued measurement.

If the lastmentioned system is used for the measurement and possible control of the flow to and from a dialyser, the same is appropriately provided with means for the conducting of the clean dialysis solution through both the ducts. At the same time means can be provided for the by-passing of the flow from the dialyser past the two ducts thus allowing the dialysis to be continued, at least to a limited extent,

during the zeroing or calibration. At the same time a certain clean-flushing of the contaminated ducts is achieved.

The invention is used preferably for an arrangement wherein the said electrodes are arranged in a manner known in itself in a magnetic field crossing the two ducts. Signals emitted from the electrodes can then be picked up and used directly for the adjustment in case of large differences in the flows, whilst the difference in signals can be picked up and used for adjustment in case of small differences in the flows.

BRIEF DESCRIPTION OF DRAWINGS

Fig.1 shows schematically a block diagram of an arrangement in accordance with the invention in a preferred embodiment.

Fig.2 and 3 likewise schematically show alternative possibilities of connection for two parallel flows whose differences in flow rates can be measured with the help of the arrangement in accordance with the invention.

BEST MODE OF CARRYING OUT THE INVENTION

In fig.1 are shown two ducts 1 and 2 with four electrodes 3,4,5 and 6 which are connected to differential measuring instruments 7 and 8 respectively which in turn are connected to a differential measuring instrument 9. All differential measuring instruments are connected to a microcomputer 10. The flows in the twc ducts 1 and 2 are subjected to a magnetic field generated with the help of the coils 11 and 12, operated by a source of current 13, which in turn is controlled by the computer 10. It is shown schematically how the computer can be provided with a display 14 and a controller 15. At the same time the micro-

computer can be adapted so as to control one or more valves 16. With regard to the theories behind the measurement in accordance with the system shown, reference is made to the aforementioned British publications. In this connection it may be mentioned that the broken lines 17 and 18 are intended to indicate that the measured values obtained from the differential measuring instruments 7 and 8 are used directly for the control of the computer 10. This is done in the case of large differences between the flows in the ducts 1 and 2. In the case of small differences the difference obtained from the differential measuring instrument 9 is used instead for the control of the microcomputer 10. Naturally the system may be provided for this purpose with different types of amplifiers, rectifiers, earth electrodes and other electric components which are normal for anyone versed in the art.

In fig.1 the ducts 1 and 2 are shown in a cross-section transversely to the direction of flow. In fig.2 the corresponding ducts are shown instead in their longitudinal direction. Ducts 1 and 2 are combined with two valve blocks 16a and 16b by means of which the flows from ducts 1 and 2 respectively can be changed over alternately to the opposite duct, so that ultimately all electrodes and/or duct walls are acted upon to a substantially equal extent.

In fig.3 the ducts 1 and 2 are also shown in longitudinal direction. If the system in accordance with fig.3 is used, for example, in dialysis, the arrow 19 may designate the flow from a control unit normally used for dialysis. The arrow 20 in this case designates the flow to the actual dialyser and the arrow 21 the flow from the dialyser. The arrow 22 in this case designates the flow to a drain and/or to a possible regeneration and recirculation. In the bottom part of fig.3 the arrow 23 indicates how the

clean dialysis solution can be conducted first through the duct 1 and then through the duct 2 to be removed finally to a drain or the like without passing the dialyser. At the same time the arrow 24 is meant to indicate how the flow from the dialyser can be conducted, past the two ducts 1 and 2, directly to the drain. The system in accordance with fig.3 has the advantage over the system in accordance with fig.2 that there is no risk of any particles broken loose from a previously contaminated duct being passed to the dialyser. In accordance with this system any contaminations broken off are passed instead directly to the drain.

Naturally the invention is not limited simply to the preferred embodiment described above, but can be varied within the scope of the following claims. The invention is also applicable, for example, to systems with more or fewer electrodes. Likewise it is not necessary to have parallel flow, but the system can also be adapted to counter-current flow. Finally it may be mentioned that the calibration in accordance with the system shown in fig.3 can be repeated more or less frequently at regular intervals. In the case of dialysis it has been found to be appropriate to calibrate once every half hour. The calibration may proceed in such a manner that the flow difference is measured 300-400 times in a minute, whereupon a mean value is calculated which is substantially independent of any background noise.

CLAIMS

1. An arrangement for the measurement of the difference between two flows in two separate ducts (1,2) with the help of one or more monitoring electrodes (3-6) or the like arranged in respective ducts, c h a r a c t e r i z e d i n t h a t the flow in the one duct (1) is adapted so that it is capable of being transferred to the other duct (2).

2. An arrangement in accordance with claim 1, the respective flows causing the respective electrodes or the like to be acted upon to a different extent, c h a r a c t e r i z e d by means (16;16a;16b) for the alternate change-over of the flows from the respective ducts (1,2) to the opposite duct (2 and 1 respectively), so that ultimately all the electrodes (3-6) and/or duct walls are acted upon to a substantially equal extent.

3. An arrangement in accordance with claim 1, the respective flow acting upon one or more electrodes and/or the duct walls and consequently the measuring result, c h a r a c t e r i z e d by means (23) for conducting one and the same flow through both ducts (1,2), when the flow difference becomes zero and the measured value can be used as a new zero value for the continued measurement.

4. An arrangement in accordance with claim 3, intended for the measurement and possible control of the flow to and from a dialyser, c h a r a c t e r i z e d by means (23) for the conducting of the clean dialysis solution through both the ducts (1,2).

5. An arrangement in accordance with claim 4, c h a r a c t e r i z e d by means (24) for the by-passing of the flow from the dialyser past the two ducts (1,2), thus allowing the dialysis to be continued, at least to a limited extent, during the zeroing or calibration.

6. An arrangement in accordance with anyone of the preceding claims, c h a r a c t e r i z e d i n t h a t the said electrodes (3-6) are arranged in a manner known in itself in a magnetic field crossing the two ducts (1,2), making it possible for outgoing signals to be picked up and used directly for adjustment in case of large differences in the flows, whilst the difference in signals is picked up and used for adjustment in case of small differences in the flows.

Fig.1

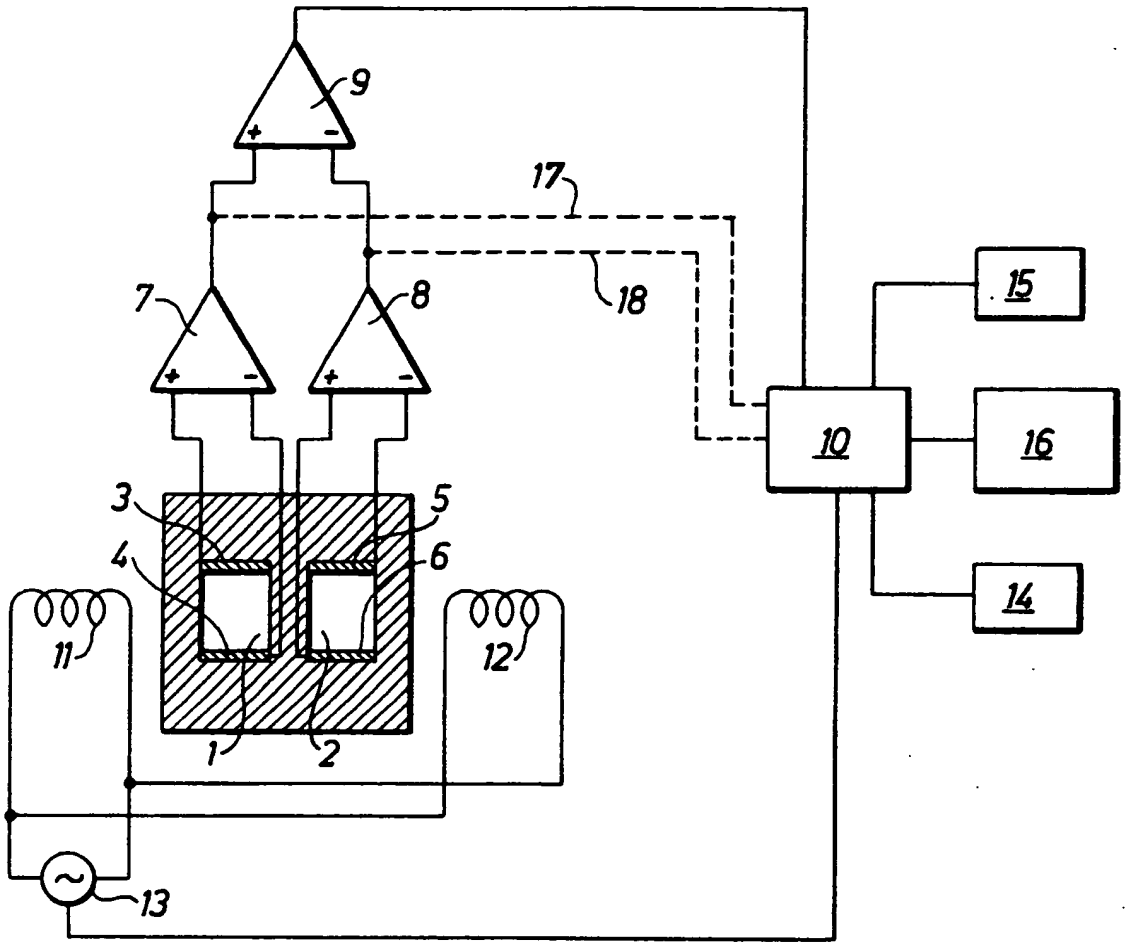

Fig.2

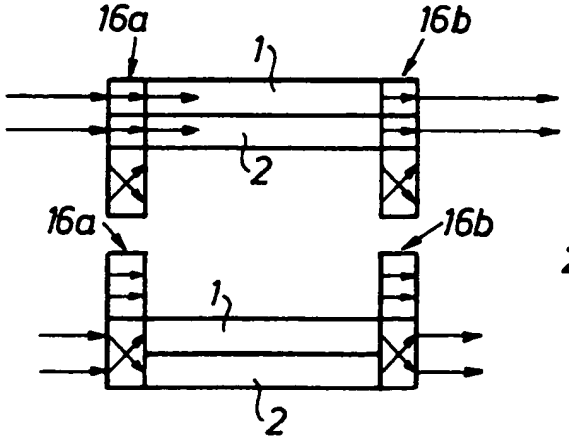

Fig.3